PATENT SPECIFICATION

597,501

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PROVISIONAL SPECIFICATION

Improvements in or relating to Apparatus for Bringing Gases into Contact with Solids

We, THE GAS LIGHT & COKE COMPANY, a British Company, [Dr.] ROLAND HALL GRIFFITH, a British Subject, and JOHN HERBERT GEOFFREY PLANT, a British Subject, all of 30, Kensington Church Street, London, W.8, do hereby declare the nature of this invention to be as follows: —

This invention is for improvements in or relating to apparatus for bringing gases into contact with solids and has particular though not exclusive reference to apparatus for carrying out catalytic reactions wherein gases are brought into contact with solid catalysts.

It is an object of the invention to provide a simple and relatively cheap form of apparatus comprising a number of chambers for the solid, which chambers may be filled or emptied at will so that the apparatus as a whole may function for long periods of time, even when the catalyst is subject to fouling and has to be replaced periodically.

According to the present invention, apparatus for bringing gases into contact with solids comprises two or more reaction chambers adapted to be directly connected in series and arranged for substantially horizontal gas flow therethrough, a grid, grating or the like separating contiguous chambers and each chamber being provided with valved inlet and outlet ducts for the introduction or withdrawal of solid respectively by gravity.

The reaction chambers are preferably of similar size and shape and the series may conveniently terminate at each end in a funnel-shaped vessel connected to the ducts for the gas.

It is important that the chambers are of such a shape and disposition that they may be filled completely with the solid catalyst to avoid short circuiting. A convenient form of chamber is one which is square in cross-section and is arranged with one corner vertically above the diagonally opposite corner, the inlet and outlet ducts for the solid being arranged in these two corners and the gas flow taking place between the square end faces of the chamber.

The various chambers may contain the same or different solids or the same solid in different degrees of activity and means may be provided for maintaining the various chambers at different temperatures. The rate of flow of gas through the solid and/or the time of contact of the gas with the solid in the various reaction chambers may be varied by varying the cross-section of the chambers and/or their width.

The inlet duct for the solid may conveniently extend above the chamber in order that the chamber may be completely filled with the solid.

One or more chambers of the series may be empty and means may be provided for introducing the same or another gas at an intermediate stage in the series.

By the provision of gas-tight feed hoppers and receivers any chamber or chambers of the series may be partially or completely discharged without shutting down the plant. When used in carrying out a catalytic reaction, part or the whole of the solid catalyst in any chamber may be withdrawn for reactivation and replaced by reactivated catalyst. One or more of the chambers may also be used for the activation of new or regenerated catalyst.

The chambers may conveniently be flanged so that they can be bolted together. The grids, gratings or the like constituting the vertical walls of the chambers may conveniently be made of material, e.g. of nickel-chromium alloy, which is resistant to chemical attack at the temperature employed.

While the preferred form of apparatus contains no means for disturbing the solid in the chambers it may in certain circumstances be desirable to provide such a device.

Dated this 22nd day of August, 1945.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden,
London, E.C.1,
Chartered Patent Agents.

[*Price* 1/-]

Price 4s 6d

COMPLETE SPECIFICATION

Improvements in or relating to Apparatus for Bringing Gases into Contact with Solids

We, THE GAS LIGHT & COKE COMPANY, a British Company, [Dr.] ROLAND HALL GRIFFITH, a British Subject, and JOHN HERBERT GEOFFREY PLANT, a British Subject, all of 30, Kensington Church Street, London, W.8, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is for improvements in or relating to apparatus for bringing gases into contact with solids and has particular though not exclusive reference to apparatus for carrying out catalytic reactions wherein gases are brought into contact with solid catalysts.

It is an object of the invention to provide a simple and relatively cheap form of apparatus comprising a number of chambers for the solid, which chambers may be filled or emptied at will so that the apparatus as a whole may function for long periods of time, even when the catalyst is subject to fouling and has to be replaced periodically.

According to the present invention, apparatus for bringing gases into contact with solids by substantially horizontal flow of the gas through a bed of the solid comprises two or more reaction chambers adapted to be directly connected in series, contiguous chambers being separated only by a grid or grating which occupies substantially the whole of the vertical cross sectional area of the chamber and each chamber being provided with valved inlet and outlet ducts for the introduction and withdrawal of solid respectively by gravity.

The reaction chambers are preferably of similar size and shape and the series may conveniently terminate at each end in a funnel-shaped connection to the ducts for the gas.

It is important that the chambers are of such a shape and disposition that they may be filled completely with the solid catalyst to avoid short circuiting. A convenient form of chamber is one which is basically square in cross-section and is arranged with one corner vertically above the diagonally opposite corner, the inlet and outlet ducts for the solid being arranged in these two corners and the gas flow taking place between the square end faces of the chamber.

The various chambers may contain the same or different solids or the same solid in different degrees of activity and means may be provided for maintaining the various chambers at different temperatures. The rate of flow of gas through the solid and/or the time of contact of the gas with the solid in the various reaction chambers may be varied by varying the cross-section of the chambers and/or their width.

The inlet duct for the solid may conveniently extend above the chamber in order that the chamber may be completely filled with the solid.

One or more chambers of the series may be empty and means may be provided for introducing the same or another gas at an intermediate stage in the series.

By the provision of gas-tight feed hoppers and receivers any chamber or chambers of the series may be partially or completely discharged without shutting down the plant. When used in carrying out a catalytic reaction, part or the whole of the solid catalyst in any chamber may be withdrawn for reactivation and replaced by reactivated catalyst. One or more of the chambers may also be used for the activation of new or regenerated catalyst.

The chambers may conveniently be flanged so that they can be bolted together. The grids, gratings or the like constituting the vertical walls of the chambers may conveniently be made of material, e.g. of nickel-chromium alloy which is resistant to chemical attack at the temperature employed.

While the preferred form of apparatus contains no means for disturbing the solid in the chambers it may in certain circumstances be desirable to provide such a device.

Following is a description by way of example and with reference to the accompanying drawings of one form of apparatus consisting of three reaction chambers and constructed and arranged in accordance with the present invention.

In the drawings in which like numerals denote like parts:—

Figure 1 shows a single reaction chamber in end elevation.

Figure 2 shows the chamber of Figure 1 in side elevation.

Figure 3 shows in side elevation the complete apparatus consisting of three chambers such as are shown in Figures 1 and 2 with associated funnel-shaped connections to the ducts.

Referring to the figures of the drawings.

10 are cast iron chambers;

11 are funnel-shaped connecting vessels terminating in gas ducts 12 and 13.

The chambers 10 are flanged at 14. 15 are perforated plates, grids or gratings constituting the end walls of the chambers.

16 are valves for withdrawal of solid;

17 are valved inlets for solid; and

18 are enlargements of 17.

The three chambers 10 are bolted together and to the funnel-shaped connecting vessels 11. The perforated plates, grids or gratings may conveniently have apertures which amount to 45% of the total cross-sectional area.

In the employment of the apparatus for the removal of organic sulphur compounds from coal gas, the chambers 10 and the enlargements of the valved inlets 17 are filled with nickel subsulphide catalyst, the catalyst in the enlargements providing a reserve to make good any settlement which may take place in the chambers 10.

Coal gas containing 30 grains of organic sulphur, other than as thiophene, per 100 cu. ft. is passed through the apparatus, the temperature of the gas at the inlet 12 being 220° C. and the temperature at the outlet 13, 350° C. The organic sulphur content has then been reduced to 2 grains per 100 cu. ft. (excluding sulphur present in thiophene).

When the activity of the catalyst begins to fall off, it is withdrawn from one chamber at a time via the valve 16 into a closed receiver, without interruption of the gas flow, and replaced by clean catalyst via the inlet 17. This unit may also be employed for the manufacture of new catalyst by admitting, for example, china clay pellets containing deposited nickel sulphate into the hottest chamber where the reduction to nickel subsulphide takes place.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Apparatus for bringing gases into contact with solids by substantially horizontal flow of the gas through a bed of the solid which apparatus comprises two or more reaction chambers adapted to be directly connected in series, contiguous chambers being separated only by a grid or grating which occupies substantially the whole of the vertical cross sectional area of the chamber and each chamber being provided with valved inlet and outlet ducts for the introduction and withdrawal of solid respectively by gravity.

2. Apparatus as claimed in Claim 1 wherein the reaction chambers are of similar size and shape.

3. Apparatus as claimed in Claim 1 or Claim 2 wherein the chambers are of such a shape and disposition that they may be filled completely with the solid for the purpose described.

4. Apparatus as claimed in Claim 3 wherein each of the chambers is basically square in cross-section and is arranged with one corner vertically above the diagonally-opposite corner, the inlet and outlet ducts for the solid being arranged in these two corners and the gas flow taking place between the square end faces of the chamber.

5. Apparatus as claimed in Claim 3 or Claim 4 wherein the inlet duct for the solid extends above the chamber in order that the chamber may be completely filled with the solid.

6. Apparatus as claimed in any one of the preceding claims in which there is provided gas-tight feed hoppers and receivers so that any chamber or chambers of the series may be partially or completely discharged without shutting down the plant.

7. Apparatus for bringing gases into contact with solids which apparatus is substantially as described in the specific example with reference to the accompanying drawings.

Dated this 9th day of August, 1946.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden,
London, E.C.1,
Chartered Patent Agents.

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Fig. 1.

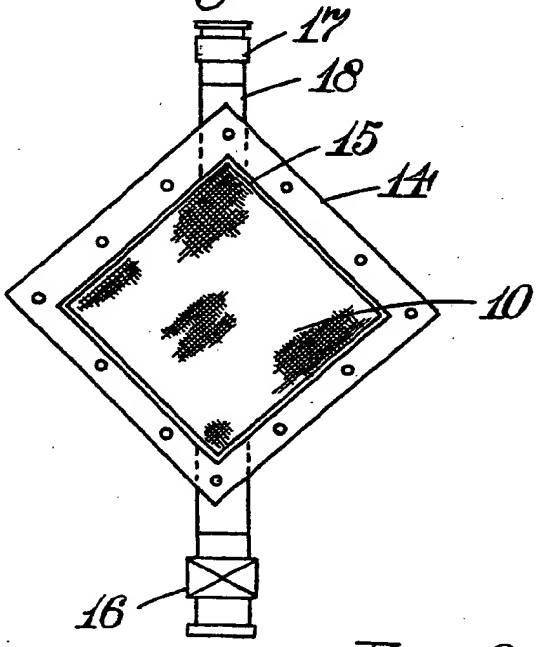


Fig. 2.

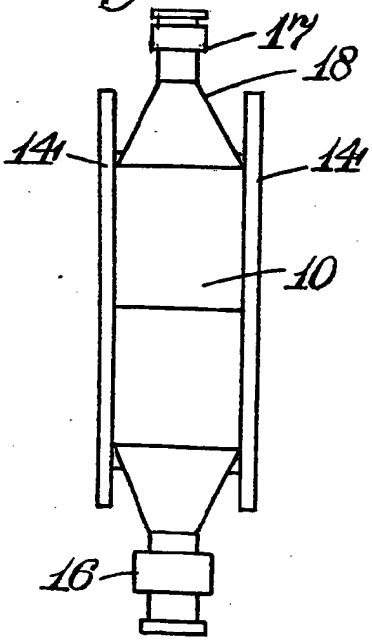
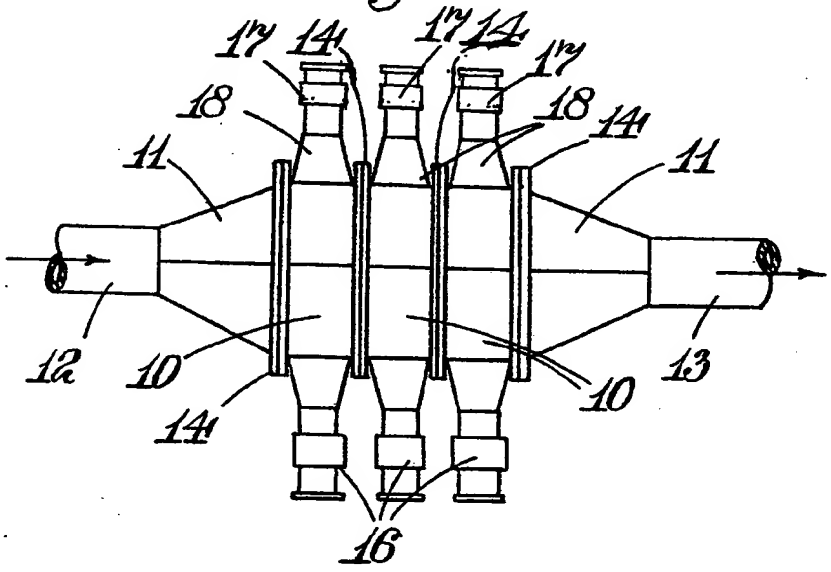


Fig. 3.



H.M.S.O. (Ty.P.)